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(54) [Title of the Invention] Voice recognition apparatus for navigation

(57) [Abstract]

[Object] To perform voice recognition processing for a place name or a facility name efficiently, reduce processing burdens imposed on a voice recognition apparatus, and improve processing speed. [Solving Means] A voice recognition dictionary for the whole Japan, the United States, or the like is divided at latitudes and longitudes, and accumulated in plural latitude/longitude division block unit voice recognition dictionaries 13. A present location signal from a navigation apparatus 28 is inputted, a block to which a present location belongs is selected, peripheral blocks present around the block are selected, and latitude/longitude division blocks corresponding to a group of these blocks are selected to create a present-location-corresponding-block-group-voice recognition dictionary 14. When a user inputs voice through a microphone 1, a voice recognizing unit 4 searches phoneme data of the present-location-corresponding-block-group-voice recognition

dictionary 14 and retrieves a place name or a facility name corresponding to the inputted voice. When plural candidates are present, a plural-candidates-narrowing-down processing unit 20 narrows the list of the candidates according to a category or a distance from the present location.

[Claims]

[Claim 1] A voice recognition apparatus for navigation, comprising:

a block-unit-voice-recognition-dictionary accumulating unit having plural block-unit-voice-recognition dictionaries constituted by recorded phoneme data of place names and facility names, which are included in blocks divided at latitudes and longitudes and related data thereof, for each of the blocks;

a present-location-corresponding-block-group selecting unit that selects a present location belonging block to which a present location belongs and peripheral blocks in a predetermined range around the present location belonging block; and

a present-location-corresponding-block-group-voice recognition dictionary obtained by selecting a block-unit-voice-recognition dictionary of a group of blocks selected by the present-location-corresponding-block-group selecting unit from the block-unit-voice-recognition-dictionary accumulating unit,

the voice recognition apparatus for navigation being characterized by comprising a voice recognition processing unit for retrieving and outputting phoneme data corresponding to an inputted voice of a place name or a facility name from the present-location-corresponding-block-group-voice recognition dictionary.

[Claim 2] The voice recognition apparatus for navigation according

to claim 1, characterized in that the blocks divided at latitudes and longitudes are divided with a size of the blocks changed such that the quantities of place names and facility names included in each of the blocks are set as equal as possible.

[Claim 3] The voice recognition apparatus for navigation according to claim 1, characterized in that blocks around the block to which the present location belongs is set as blocks adjacent to the present location belonging block.

[Claim 4] The voice recognition apparatus for navigation according to claim 1, characterized in that the blocks around the block to which the present location belongs includes blocks adjacent to the present location belonging block and blocks in a predetermined range around the blocks.

[Claim 5] The voice recognition apparatus for navigation according to claim 1, characterized in that the blocks around the block to which the present location belongs are changed as the present location moves such that the quantities of place names and facility names are set as equal as possible.

[Claim 6] The voice recognition apparatus for navigation according to claim 1, characterized in that the voice recognition processing unit sets a degree of approximation of voice for a place name or a facility name included in the present-location-corresponding-block-group-voice recognition dictionary larger as the place name or the facility name is present

in a block closer to the present location.

[Claim 7] The voice recognition apparatus for navigation according to claim 1, characterized in that: the present-location-corresponding-block-group-voice recognition dictionary consists of a list in which blocks of a group of preset location corresponding blocks are recorded; and

the voice recognition processing unit retrieves a place name or a facility name having phoneme data corresponding to an inputted voice from dictionary data of blocks recorded in the list of the block-unit-voice-recognition-dictionary accumulating unit on the basis of the list in which the blocks are recorded.

[Claim 8] The voice recognition apparatus for navigation according to claim 1, characterized in that the present-location-corresponding-block-group selecting unit performs processing for selecting peripheral blocks when a block to which a present location belongs changes because of movement of the present location and a new present-location-belonging-block is selected.

[Claim 9] The voice recognition apparatus for navigation according to claim 1, further comprising a plural-candidates-narrowing-down processing unit, the voice recognition apparatus for navigation being characterized in that the plural-candidates-narrowing-down processing unit performs narrowing-down processing when plural candidates are present as a result of voice recognition processing

by the present-location-corresponding-block-group-voice recognition dictionary.

[Claim 10] The voice recognition apparatus for navigation according to claim 9, further comprising a voice-by-category recognition dictionary in which place names and facility names are recorded for each category, the voice recognition apparatus for navigation being characterized in that the plural-candidates-narrowing-down processing unit performs voice recognition processing using the voice-by-category recognition dictionary corresponding to a category instructed by a user.

[Claim 11] The voice recognition apparatus for navigation according to claim 9, characterized in that:

the plural-candidates-narrowing-down processing unit includes a candidate-point-distance-order arranging unit for calculating distances from the present location for plural candidates obtained as a result of voice recognition processing, respectively, and arranging the plural candidates in order of the distances based on a calculated result, and

the plural candidates are displayed in order as a list on a display unit according to an output of the candidate-point-distance-order arranging unit and the user selects a place name or a facility name according to the list.

[Claim 12] The voice recognition apparatus for navigation according to claim 9, characterized in that,

distances from the present location for plural candidates obtained as a result of voice recognition processing are calculated respectively, and a candidate with the closest distance is outputted as a result of voice recognition.

[Detailed Description of the Invention]

[0001]

[Technical Field to which the Invention belongs] The present invention relates to a voice recognition apparatus for a navigation apparatus that can recognize voice inputted by a user through a microphone and perform destination setting and various kinds of retrieval in the navigation apparatus. In particular, the present invention relates to a voice recognition apparatus for a navigation apparatus provided with a voice recognition dictionary that can be used for retrieving data corresponding to a voice representing a place name, a facility, or the like inputted by a user, at high speed.

[0002]

[Prior Art] For example, a conventional navigation apparatus 30 shown in Fig. 15 includes a map/information storage medium 32 such as a CD-ROM or a DVD-ROM having recorded therein various kinds of data such as map/information data 33 in which map data for rendering a map and various kinds of information are recorded, and place name/facility name corresponding point data 34 in which latitude/longitude data at points corresponding to place names and

facility names is recorded as described later. Among the data in the map/information storage medium 32, map data centering a point indicated by a system control unit 31 in a map rendering unit 35 is read out and combined with other various kinds of images in an image combining device 36. A map and information related to the map are rendered in various forms such as 3D on an image display device 37.

[0003] A manual operation input unit 40 is connected to the system control unit 31. An operation signal from a manual operation unit, such as a remote controller, a key switch, or a touch panel, operated by a user is inputted to the system control unit 31. Due to the progress in the voice recognition technique in recent years, a voice recognition apparatus is also incorporated in a navigation apparatus. The navigation device 30 in Fig. 15 includes a voice recognition apparatus 50 that recognizes voice of a user inputted through a microphone 51. The voice recognition apparatus 50 performs voice recognition processing as will be described later, to thereby output the recognized voice of the user to the system control unit 31 of the navigation apparatus 30 from a recognition result output unit 58 to be used as an instruction signal from the user in the same manner as in the manual operation input unit 40.

[0004] According to such various operation instruction signals from the user, a destination/course point setting unit 44 sets a point indicated by the user as a destination or a course point. Concerning

a present location, the destination/course point setting unit 41 detects an accurate present location by using, for example, a GPS signal, a vehicle speed sensor, or a traveling direction sensor. The destination/course point setting unit 41 reads out map data centering this present location from the map data stored in the map/information storage medium 32, displays the map data on the image display device 37, and displays a present location of a vehicle on the map data such that the user can see at a glance where the vehicle is running.

[0005] A guiding route calculating unit 42 is connected to the system control unit 31. On the basis of the present location and the destination and course point, the guiding route calculating unit 42 uses link data recorded in the map/information storage medium 32, automatically searches for a most suitable route among routes connecting these points in view of conditions such as time, a distance, and a fare, to set the route as a guiding route. A part of the roads on a map image corresponding to the guiding route is rendered thick in a different color such that the guiding route can be displayed on a screen.

[0006] To allow the user to drive the vehicle surely along the guiding route set as described above, for example, when the vehicle enters within a predetermined distance of an intersection on the guiding route where the vehicle should change a course, a guiding route showing unit 43 displays the intersection enlarged and renders an

arrow or the like for indicting a direction in which the course should be changed on the screen, or guides the driver for right or left turn with voice so that the user can be guided to the destination.

[0007]

[Problems to be solved by the Invention] In designating the destination or the course point or in retrieving and displaying a specific point on the screen, various kinds of means have been adopted conventionally. For example, there has been adopted a method, according to which: data, which are obtained by arranging place names in a form of a list in order from a wide area side to a narrow area side, are stored in the map/information storage medium 32 in advance; a user inputs place names in order from a name of a prefecture using a keyboard or the like on the screen in the same system as the usual address display to thereby specify the place name or select place names, which are displayed in order from the wide area side on the screen, by instructing and inputting the place names using a cursor to thereby finally narrow down the place names to a specific place name.

[0008] Further, there has been adopted a method, according to which: names of public facilities such as stations and city halls, facilities such as crossings and interchanges, and facilities such as landmark buildings, convenience stores, gas stations, and restaurants are stored in the map/information storage medium 32; a user inputs a

facility name directly, or displays a list of candidate facility names and selects the facility names by instructing and inputting the facility names using a cursor to thereby narrow down the facility names to a specific facility name. The specific place name or the specific facility name set in this way is inputted to a place name/facility name for retrieval input unit 45 in Fig. 15. A point data retrieving unit 46 retrieves point data, which indicates a latitude and longitude corresponding to this place name or facility name, from the place name/facility name corresponding point data 34 of the map/information storage medium 32. This data is set as point data of a destination or a course point, or data representing this point on a map screen.

[0009] It is not preferable for a driver to manually search for a place name or a facility name as described above while the driver is driving a vehicle. In order to solve this problem, a place name/facility name dictionary unit 56 is provided in a voice recognition dictionary unit 55, and when a place name or a facility name is inputted by a user through a microphone 51, the place name or the facility name is inputted to a voice characteristic parameter extracting unit 53 through a voice input unit 52; a characteristic parameter of the voice obtained in the voice characteristic parameter extracting unit 53 is outputted to a voice recognizing unit 54; and the voice recognizing unit 54 retrieves a place name or a facility name having a parameter that matches this parameter best from the

place name/facility name dictionary unit 56 and outputs this place name or facility name to the place name/facility name for retrieval input unit 45 from a recognition result output unit 58, to thereby allow the driver to search for a place name or a facility name using the voice recognition apparatus 50 described above. The place name or the facility name according to voice recognition, which are inputted to the place name/facility name for retrieval input unit 45, is outputted to the point data retrieving unit 46 as in the case of the above-described manual input by a user. Point data corresponding to the specific place name or facility name is obtained in the same manner as described above and used for destination setting, display on a map, and the like.

[0010] It is possible to directly search for a place name or a facility name with voice in this way. It is also conceivable that, in inputting the voice, a user utters place names in sequential order from a name of a prefecture in the same manner as the input by the manual operation to thereby narrow the list of candidates of place names to be selected and reduce burdens of voice recognition processing. However, in that case, the user has to input voice many times, which is inconvenient. Therefore, it is preferable to allow the user to set this place name portion, by simply uttering a place name portion in detail as much as possible. When there are plural points corresponding to the place name in this case, it is preferable to take action to display candidate points as a list or to display

the candidate points on a map.

[0011] For that purpose, in retrieving a specific place name or facility name, for example, "Yoshima" as a place name, or a "twin tower" as a facility name, it is necessary to retrieve the place name or the facility name out of all place names or facility names throughout Japan recorded in the place name/facility name dictionary unit 56. When one place name or facility name is retrieved out of such enormous data, heavy burdens are imposed on a processing unit for performing this arithmetic processing, processing time is extended, and a recognition rate falls inevitably. If a high-performance arithmetic processing unit is used, the voice recognition apparatus becomes expensive inevitably.

[0012] In order to solve this problem, it is conceivable to divide data in the place name/facility name dictionary unit 56 into predetermined regions by a unit of prefecture or the like, perform input in advance for specifying a region in retrieving a specific place name or facility name, or a region including a point where a vehicle is present currently is specified according to data of a present location of a navigation apparatus, and using only a voice recognition dictionary included in the specific region by a unit of prefecture or the like in performing voice recognition.

[0013] However, if a place name/facility name dictionary targeting specific regions is simply referred to in this way, when a person comes and goes across regions, for example, a person in a border

of Ibaraki prefecture and Fukushima prefecture uses this navigation apparatus when the person comes and goes between the prefectures, voice recognition for place names present in the adjacent regions is not performed, which makes the apparatus very difficult to use.

[0014] In order to solve the problem, it is conceivable to solve the problem by, for example, selecting a voice recognition dictionary so as to include prefectures adjacent to a prefecture including a point where a vehicle is present currently. In that case, for example, when a present location is in Fukushima prefecture, Ibaraki prefecture, Tochigi prefecture, Niigata prefecture, Yamagata prefecture, and Miyagi prefecture are selected. As a result, an extremely large area is selected. In addition, for example, when a present location is in Tokyo, a region including Kanagawa prefecture, Yamanashi prefecture, Saitama prefecture, and Chiba prefecture is selected, which is a relatively small area, but a population density thereof is extremely high. As a result, place names and facility names included in the region increases in proportion to the population density. Further, for example, when a present location is in Shimane prefecture, a region simply including Yamaguchi prefecture, Hiroshima prefecture, and Tottori prefecture is selected, which is a relatively small area and a population density thereof is relatively low. As a result, the number of place names and the number of facility names in this region are relatively small.

[0015] In this way, an area including place names and facility names

targeted by the voice recognition dictionary and the number of place names and facility names fluctuate greatly. Therefore, it is conceivable to adjust a voice recognition apparatus to a region with an amount of data about in the middle of all regions. However, in that case, when a vehicle currently in Tokyo uses this voice recognition apparatus as described above, processing speed of the voice recognition apparatus falls inappropriately to irritate a user. Even when the vehicle is present in Tokyo, when a high-performance arithmetic processing unit having processing ability enough for performing voice recognition processing at high speed and accurately is used, the processing ability is excessive in almost all the other regions.

[0016] The problems described above are not limited to Japan but are the same in, for example, the Unite States. When a voice recognition dictionary is set to target, for example, "states" adjacent to one another, depending on a state, significant differences occur in the number of place names and facility names including those in the adjacent states and an area of a region to be targeted as in the example in Japan.

[0017] Therefore, it is a main object of the present invention to provide a voice recognition apparatus for navigation that can perform voice recognition at high speed and accurately, using an inexpensive data processing device by setting, in performing voice recognition processing using a voice recognition dictionary in which place names

and facility names are set for each region, a voice recognition dictionary in an appropriate range and selecting the voice recognition dictionary appropriately.

[0018]

[Means for solving the Problems] In order to solve the above problems, the voice recognition apparatus for navigation according to the present invention includes: a block-unit-voice-recognition-dictionary accumulating unit having plural block-unit-voice-recognition dictionaries constituted by recorded phoneme data of place names and facility names, which are included in blocks divided at latitudes and longitudes and related data thereof, for each of the blocks; a present-location-corresponding-block-group selecting unit that selects a present location belonging block to which a present location belongs and peripheral blocks in a predetermined range around the present location belonging block; and a present-location-corresponding-block-group-voice recognition dictionary obtained by selecting a block-unit-voice-recognition dictionary of a group of blocks selected by the present-location-corresponding-block-group selecting unit from the block-unit-voice-recognition-dictionary accumulating unit, and includes a voice recognition processing unit that retrieves and outputs phoneme data corresponding to inputted voice of a place name or a facility name from the

present-location-corresponding-block-group-voice recognition dictionary.

[0019] Further, in another voice recognition apparatus for navigation according to the present invention, the blocks divided at latitudes and longitudes are divided with a size of the blocks changed such that the quantities of place names and facility names included in each of the blocks are set as equal as possible.

[0020] Further, in another voice recognition apparatus for navigation according to the present invention, blocks around the block to which the present location belongs is set as blocks adjacent to the present location belonging block.

[0021] Further, in another voice recognition apparatus for navigation according to the present invention, the blocks around the block to which the present location belongs is adapted to include blocks adjacent to the present location belonging block and blocks in a predetermined range around the blocks.

[0022] Further, in another voice recognition apparatus for navigation according to the present invention, the blocks around the block to which the present location belongs are changed as the present location moves such that the quantities of place names and facility names are set as equal as possible.

[0023] Further, in another voice recognition apparatus for navigation according to the present invention, the voice recognition processing unit sets a degree of approximation of voice for a place

name or a facility name included in the present-location-corresponding-block-group-voice recognition dictionary larger as the place name or the facility name is present in a block closer to the present location.

[0024] Further, in another voice recognition apparatus for navigation according to the present invention, the present-location-corresponding-block-group-voice recognition dictionary consists of a list in which blocks of a group of preset location corresponding blocks are recorded, and the voice recognition processing unit retrieves a place name of a facility name having phoneme data corresponding to an inputted voice from dictionary data of blocks recorded in the list of the block-unit-voice-recognition-dictionary accumulating unit on the basis of the list in which the blocks are recorded.

[0025] Further, in another voice recognition apparatus for navigation according to the present invention, when a block to which a present location belongs changes because of movement of the present location and the present-location-belonging-block selecting unit selects a new present location belonging block to which the present location belongs, processing for selecting peripheral blocks is performed.

[0026] Further, another voice recognition apparatus for navigation according to the present invention includes a plural-candidates-narrowing-down processing unit. The

plural-candidates-narrowing-down processing unit performs narrowing-down processing when plural candidates are present as a result of voice recognition processing by the present-location-corresponding-block-group-voice recognition dictionary.

[0027] Further, another voice recognition apparatus for navigation according to the present invention includes a voice-by-category recognition dictionary in which place names and facility names are recorded for each category. The plural-candidates-narrowing-down processing unit is adapted to perform voice recognition processing using the voice-by-category recognition dictionary corresponding to a category instructed by a user.

[0028] Further, in another voice recognition apparatus for navigation according to the present invention, the plural-candidates-narrowing-down processing unit has a candidate-point-distance-order arranging unit for calculating distances from the present location for plural candidates obtained as a result of voice recognition processing, respectively, and arranging the plural candidates in order of the distances based on a calculated result, and displays the plural candidates in order as a list on a display unit according to an output of the candidate-point-distance-order arranging unit such that the user selects a place name or a facility name according to the list.

[0029] Further, another voice recognition apparatus for navigation

according to the present invention is adapted to calculate distances from the present location for plural candidates obtained as a result of voice recognition processing, respectively, and outputs a candidate with the closest distance as a result of voice recognition.

[0030]

[Embodiment of the Invention] An embodiment of the present invention will be explained with reference to the drawings. Fig. 1 is a functional block diagram showing main functional units of a voice recognition apparatus for navigation according to the present invention and a relation among the functional units. Fig. 1 shows a functional block for performing voice recognition processing of the present invention in the part of the conventional voice recognition apparatus 50 shown in Fig. 15. In Fig. 1, voice through a microphone 1 is inputted from a voice input unit 2. A voice characteristic parameter extracting unit 3 extracts a characteristic of the inputted voice and outputs the extracted characteristic to a voice recognizing unit 4. The voice recognizing unit 4 selects various dictionaries of a voice recognition dictionary unit 5 according to circumstances and retrieves phoneme data matching the extracted characteristic parameter of the voice out of phoneme data of the selected dictionary.

[0031] The voice recognition dictionary unit 5 includes a place name/facility name dictionary unit 6 similar to the conventional place name/facility name dictionary unit 56 shown in Fig. 15 such

that voice recognition processing using this dictionary can be performed when a user inputs a place name in order to set a destination and a course point, when the user inputs a facility serving as a standard at the time of destination or course point setting, or when the user tries to use a specific facility while driving a vehicle. The voice recognition dictionary unit 5 includes, in addition to such place names and facility names, a dictionary 7 for performing other functions such as an operation function in order to acoustically operate to perform various functions of a navigation apparatus to expand and reduce a scale of a map displayed and to change map display into 3D display, for example. Note that the selection of a dictionary can also be used for judging whether a voice predetermined for operating a function of the navigation apparatus is included in the inputted voice using the dictionary 7 for performing other functions such as an operation function, and for determining that the voice is voice concerning a place name or a facility name when such a voice is not included.

[0032] As shown in Fig. 5(a), the place name/facility name dictionary unit 6 includes a latitude/longitude division-block voice recognition dictionary 13. The latitude/longitude division-block voice recognition dictionary 13 is a voice recognition dictionary which includes, for example, a latitude-division area divided by latitudes a1, a2, ... and a longitude division area divided by longitudes b1, b2, .... The voice recognition dictionary records

voice recognition data for place names and facility names included in the region of the block corresponding to the intersection of the latitude-division area and the longitude-division area, location data of points where the place names and the facility names exist, and the like. In the example shown in Fig. 5(a), a block (n, m), to which a point where a present location is present belongs, is shown as a block of a region corresponding to the intersection of an n area and an m area. The n area is a latitude division area between latitudes a3 and a4, and the m area is a longitude division area between longitudes b3 and b4.

[0033] In the example in Fig. 5(a), areas n+1, n+2 and n-1, n-2 are shown around the n area, which is the latitude division area, and areas m+1, m+2 and m-1, m-2 area shown around the m area, which is the latitude division area. As blocks where these areas cross, for example, (n+2, m-2), (n+1, m-2), (n, m-2), ... (n+2, m-1), (n+1, m-1), ... (n+2, m-1), (n+1, m-1), ... and (n-2, m+2) are present.

[0034] The place name/facility name dictionary unit 6 in Fig. 1 inputs a present location signal of a functional unit for detecting a present location of a vehicle, such as the present location detecting unit 41 in Fig. 15 included in a navigation apparatus 28, from a present location input unit 10. A present-location-belonging-block selecting unit 11 selects a present location belonging block out of the voice recognition dictionaries divided for each of the blocks as described above, which are accumulated in the latitude/longitude

division block voice recognition dictionary 13, according to the present location signal inputted from the present location input unit 10. In the example shown in Fig. 5(a), since the present location of the vehicle is present in the block (n, m) as described above, this block is to be selected.

[0035] When the present location belonging block is selected in this way, the data is outputted to a peripheral block selecting unit 12. The peripheral block selecting unit 12 selects peripheral blocks predetermined so as to select, for example, all peripheral blocks adjacent to and surrounding the block where the present location is present. Fig. 5(b) shows an example in such a case. Eight blocks in total, namely, (n+1, m-1), (n, m-1), (n-1, m-1), (n+1, m), (n-1, m), (n+1, m+1), (n, m+1), and (n-1, m+1) adjacent to and surrounding the block (n, m) to which the present location belongs, are selected as peripheral blocks.

[0036] In Fig. 1, block unit voice recognition dictionaries, which corresponds to nine blocks in total including the one block selected by the present-location-belonging-block selecting unit 11 and the eight blocks selected by the peripheral block selecting unit 12, are extracted and accumulated in a present-location-corresponding-block-group voice recognition dictionary 14. The voice recognizing unit 4 performs voice recognition processing for place names and facility names using this present-location-belonging-block-group voice recognition

dictionary 14.

[0037] The present-location-belonging-block selecting unit 11 constantly detects whether the present location is present in a range of the block, to which the present location belongs, selected earlier according to the present location signal that changes as the vehicle moves. When the vehicle moves from the block to another block, the present-location-belonging-block selecting unit 11 immediately selects a new block to which the present location belongs. Fig. 5(c) shows this state. When the vehicle moves from a point P on a road L of the block (n, m), passes a boundary point Q of the block (n, m) and the block (n, m+1), enters the block (n, m+1), and travels in a direction of a point R, the present-location-belonging-block selecting unit 11 detects that the block, to which the present location belongs, has changed to the block (n, m+1) at the point when the vehicle passes the boundary point Q and selects the block (n, m+1).

[0038] The present-location-belonging-block selecting unit 11 outputs a result of the selection to the peripheral block selecting unit 12. The peripheral block selecting unit 12 selects eight blocks around the block, to which the present location belongs, in the same manner as described above. As a result of such selection, as shown in Fig. 5(d), the present location belonging block (n, m+1) and the eight blocks in total, namely, (n+1, m), (n, m), (n-1, m), (n+1, m+1), (n-1, m+1), (n+1, m+2), (n, m+2), and (n+1, m+2) around

the block (n, m+1) are selected.

[0039] Voice recognition dictionaries corresponding to the nine blocks selected as described above are accumulated in the present-location-block-group voice recognition dictionary 14. For example, when a user wishes to find 7-Eleven Koyamaotome branch at the point Q, the user inputs voice "7-Eleven Koyamaotome branch" through a microphone. Then, the voice recognizing unit 4 retrieves facility names close to the inputted voice in the present-location-corresponding-block-group voice recognition dictionary 14 so as to find out facility names present near the vehicle such as "Seven Eagle" (sports shop) and "Seven East" (travel agency) other than "7-Eleven ...".

[0040] In setting the blocks to be divided by the latitudes and the longitudes as shown in Fig. 5(a), the latitudes and the longitudes can be set arbitrarily. However, when the blocks are set in a small region, the number of place names and facility names included in a group of blocks is small. Therefore, when a desired place name or facility name is present in this data, since an overall amount of data to be retrieved by the voice recognizing unit 4 is small, it is possible to perform voice recognition processing at high speed even if a CPU with the same processing speed is used. However, since a target range of voice recognition is limited, it is highly likely that no place name or facility name is present in the group of blocks. Thus, voice recognition processing is not performed appropriately

in this regard.

[0041] Conversely, when the blocks to be divided by the latitudes and the longitudes are set in a large region, the number of place names and facility names included in a group of blocks is large and an overall amount of data retrieved by the voice recognizing unit 4 increases. Thus, it takes longer time to perform voice recognition processing when a CPU of the same processing speed is used. However, since a target range of voice recognition is large, it is highly likely that a place name or a facility name intended by the user is present in the group of blocks. Thus, voice recognition processing is performed appropriately in this regard.

[0042] In this way, in setting a target range of voice recognition appropriately, target regions to be searched through are significantly different, for example, when a place name of a destination present far from a present location is inputted acoustically in setting a guiding route and when 7-Eleven near the present location is searched for in order to do shopping while the vehicle is traveling along the guiding route. Thus, the range may be set in advance such that the range can be selected arbitrarily when a selection range of peripheral blocks is narrowed and when a selection range of peripheral blocks is widened according to a situation in which voice recognition is performed. In that case, a selection range adjusting unit may be provided in the peripheral block selecting unit 12 in Fig. 1 to select a range arbitrarily

depending on a user or distinguish voice input for setting a guiding route and voice input during traveling along the guiding route and automatically change the range.

[0043] Fig. 6(a) shows an example at the time when the selection range adjustment for peripheral blocks described above is performed. When a present location is present in a block S1 where a latitude division area between latitudes a5 and a6 and a longitude division area between longitudes b5 and b6 cross each other, a group S2 of nine blocks included in an area between latitudes a4 and a7 and between longitudes b4 and b7 is selected as peripheral blocks when a range of peripheral blocks is set narrow. A group S3 of forty-nine blocks included in an area between latitudes a2 and a9 and between longitudes b2 and b9 is set when a range of peripheral blocks is set wide. As such setting for a group of blocks, other than always setting the group of blocks in the same size in all areas, it is also possible to change the setting automatically to set the group of blocks in a narrow range in a region with many place names and facility names and set the group of blocks wide in a region with few place names and facility names.

[0044] In setting a predetermined range of the voice recognition dictionaries described above, for example, it is possible to set, for the group of blocks obtained by setting a mesh of latitudes and longitudes fine as shown in Fig. 6(a) to select the group S3 of forty-nine blocks selected wide, substantially the same voice

recognition dictionaries as a group of blocks obtained by setting a mesh of latitudes and longitudes large as shown in Fig. 6(b) to select the group of blocks as a group of peripheral blocks T2 of nine blocks around a block T1 to which a present location belongs between latitude c3 and c4 and between longitudes d3 and d4. It is possible to select a group of voice recognition dictionary arbitrarily according to such adjustment.

[0045] Note that, as shown in Fig. 6(a), when setting for a group of blocks S2 adjacent to the block S1 to which the present location belongs and a group of blocks S3 in a range set appropriately around the group of blocks S2 is performed, other than changing selection of a group of blocks arbitrarily as described above, it is also possible to set a weighting coefficient for processing for calculating a degree of approximation with inputted voice in voice recognition processing larger as a place name or a facility name is closer to the block S1 to which the present location belongs and judge that the place name or the facility name is a name intended by a user. By performing such setting, it is possible to perform more accurate voice recognition. However, it is possible to further reduce burdens of voice recognition processing when an arithmetic operation is performed collectively for each block as described above rather than calculating distances from a present location for, for example, all place names and facility names.

[0046] Moreover, in setting a range of voice recognition

dictionaries, it is preferable to set the number of points of place names and facility names included in each block within a predetermined range taking into account processing ability of a voice recognition apparatus. In that case, the number of points is set within a range in which this voice recognition apparatus can cope with in a group of blocks with a largest number of points in groups of blocks obtained as a result of dividing place names and facility names into blocks.

[0047] In coping with a block with a large number of points of place names and facility names, even if a block has a larges number of place names and facility names as described above, when the place names and the facility names are fragmented in all ranges into a size that a voice recognition apparatus to be used can cope sufficiently with processing ability thereof, the number of points of place names and facility names is extremely small, in contrast. Thus, the ranges may not be preferable as a range of voice recognition dictionary in some cases.

[0048] As measures against this problem, for example as shown in Fig. 7(a), a range A of a block including a region with a large number of place names and facility names is fragmented, a latitude a3 for dividing a block is set between latitudes a2 and a4, and a latitude a5 for dividing a block is set between latitudes a4 and a6. Similarly, a longitude b4 is set between longitudes b3 and b5 and a longitude b6 is set between longitudes b5 and b7. Consequently, a block having an area 1/4 as large as other blocks is formed for

the range A of the block such that the number of points of place names and facility names included in one block is uniformalized as much as possible. Moreover, when it is necessary, for example, as shown in Fig. 7(b), in the range A of the block in Fig. 7(a), in particular, a range B of a block with a large number of place names and facility names a block of a size obtained by equally dividing each block into four can be formed in, and the number of place names and facility names included in each block can be uniformed.

[0049] By dividing a block finely in this way, for example, in forming blocks for voice recognition dictionary obtained by dividing one entire country at latitudes and longitudes, for example, in a Kanto district in Japan, since a population density of a region where the capital, Tokyo is located is high, a larger number of place names and facility names are present in that region. Thus, the blocks are used in such a manner that the range A of the fragmented blocks is formed in this region and, since a particularly large number of place names and facility names are present in Tokyo in the region, the range B of blocks obtained by fragmenting this portion is formed.

[0050] For example, when the block for voice recognition dictionaries is divided as shown in Fig. 7(a), a group of blocks corresponding to a present location is selected as shown in Figs. 8(a), (b), and (c) as a car moves. In other words, as shown in Fig. 8(a), a present location is present in the part of a block F1, and a group of blocks G1 corresponding to the present location including

a group of blocks present around the block is selected. In this case, since the block F1 to which the present location belongs is adjacent to a block fragmentation range, a narrow range is selected as peripheral blocks in the part of the block fragmentation range.

[0051] Subsequently, when the present location moves from the block F1 to a block F2 of Fig. 8(b), a group of blocks G2 corresponding to the present location is selected. In this case, since the block F2 to which the present location belongs is a block in the block fragmentation range, blocks around the block is in a narrower range. Moreover, when the present location moves to a block F3 as shown in Fig. 8(c), since all blocks around the block are in the block fragmentation range, a group of blocks G3 corresponding to the present location is in a narrowest range. In this way, when a block with a large number of place names and facility names is fragmented, it is possible to perform voice recognition processing in a state in which the number of place names and facility names included in voice recognition dictionaries is always kept substantially equal. Note that the action is the same when a block is fragmented as shown in Fig. 7(b).

[0052] The voice recognizing unit 4 of Fig. 1 performs voice recognition for place names and facility names using the voice recognition dictionaries of various aspects described above. As a result of recognition of the voice recognizing unit 4, when there is only one place name or facility name corresponding to inputted

voice, the place name or the facility name is directly outputted to an output confirming unit 26. When a confirmation signal of the user is inputted from an operation signal input unit 25, this confirmation signal is outputted to the navigation apparatus 28 from a recognition result output unit 27.

[0053] In this case, when there are plural candidates of place names and facility names, in this embodiment, data of the candidates is outputted to a plural-candidates-list-display output unit 23 and a list of the candidates is displayed on a display unit 24 of the navigation apparatus. In addition, the list of the plural candidates is outputted to a voice-by-category recognizing unit 21 of a plural-candidates-narrowing-down processing unit 20 such that voice recognition can be performed for each category when a place name or a facility name intended by a user is retrieved out of those candidates. For that purpose, in this embodiment, a place name/facility name-voice-by-category recognition dictionary 15 is provided in the place name/facility name dictionary unit 6 such that voice recognition based on categories can be performed. Note that, in the example described above, when plural candidates are present as a result of recognition processing in the voice recognizing unit 4, the plural candidates are displayed on the display unit 24. However, it is also possible that instruction display for selecting a genre is performed immediately without displaying the candidates to facilitate the user to select a genre.

[0054] The user refers to a list of categories displayed separately on the display unit 24 and selects a desired category with cursor key operation or the like of a remote controller in the operation signal input unit 25 or acoustically inputs a category name separately and causes the navigation apparatus to acoustically recognize this category name to thereby output a signal of the category to the voice-by-category recognizing unit 21. Note that, in voice recognition processing in this case, the dictionary 7 for other functions such as an operation function in the voice recognition dictionary unit 5 is used. The voice-by-category recognizing unit 21 retrieves, according to the signal of the category instructed by the user, a dictionary of the corresponding category in the place name/facility name-voice-by-category dictionary 15 and retrieves and narrows down phone data matching voice inputted by the user out of phoneme data of place names and facility names recorded in dictionaries for each category.

[0055] When the plural candidates are narrowed down by the voice recognition processing in the voice-by-category recognizing unit 21 and, as a result, only one candidate is left, the candidate is directly outputted to the output confirming unit 26, and confirmation of the user is sought as described above. When the candidate is confirmed by the user, the candidate is outputted to the navigation apparatus 28 from the recognition result output unit 27. In this case, when plural candidates are still present, the candidates are

outputted to a candidate-point-arrangement-in-order-of-distance narrowing down unit 22, a distance from the present location is calculated for each of the candidates, and a list in which the candidates are arranged in order from one with a smallest distance is created. The list is outputted to the display unit 24 through the plural-candidates-list-display output unit 23 and displayed.

[0056] The user refers to this list display, selects a candidate, which is considered to be appropriate, from the operation signal input unit 25 and outputs the candidates to the candidate-point-arrangement-in-order-of-distance narrowing down unit 22. The candidate-point-arrangement-in-order-of-distance narrowing down unit 22 outputs the instructed candidate to the output confirming unit 26. The output confirming unit 26 outputs the candidate to the display unit 24 as described above and, when a confirmation signal from the user, who looks at the candidate, is inputted from the operation signal input unit, outputs the confirmation signal to the navigation apparatus 28 through the recognition result output unit 27. Note that, although the example of display of a list in which plural candidates are arranged in an order of distances is described in the embodiment, it is also possible to output a closest candidate to the output confirming unit 26 without displaying the candidates as a list and seek confirmation of the user.

[0057] In the voice recognition apparatus for navigation including

the functional blocks for performing the functions shown in Fig. 1, it is possible to actuate the functional blocks in order according to, for example, operation flows shown in Figs. 2 and 3. The operation flows will be explained with reference to the functional block diagram in Fig. 1. In performing this voice recognition processing, first, recognition voice is inputted from the user as shown in Fig. 2 (step S1). Subsequently, the voice recognition apparatus for navigation performs processing for extracting a characteristic parameter of this voice (step S2) and judges whether the inputted voice includes voice concerning a place name or a facility name (step s3).

[0058] In performing this judgment, the judgment can be performed by extracting a characteristic parameter of voice from the microphone 1 inputted by the voice input unit 2 of Fig. 1 in the voice characteristic parameter extracting unit 3 and judging in the voice recognizing unit 4 whether a dictionary corresponding to the extracted voice characteristic parameter is present in the dictionary 7 for other functions such as an operation function in the voice recognition dictionary unit 5. In the voice recognition dictionary unit 5, whereas enormous data of, for example, several million POI (Point of interest) may be present in the place name/facility name dictionary unit 6, usually, only words of about several hundreds are only present in the dictionary 7 for other functions such as an operation function. Thus, it is possible to perform the judgment described above easily by using the dictionary

for other functions such as an operation function. However, other than such a judgment method, it is possible to judge that inputted voice is voice concerning place names and facility names by detecting voice is inputted while the user is performing a destination setting input operation. In addition, it is possible to judge that, when a word "near" that is a specific term decided in advance in searching for a facility name like "a convenience store near a present location" is recognized, a word following the word is a facility name.

[0059] In this judgment, when it is judged that a place name or a facility name is included in the voice uttered by the user, the voice recognition apparatus for navigation performs processing for setting voice recognition dictionaries of place names and facility names corresponding to a present location (step S4). A processing flow for the processing is shown in Fig. 3. Although described later in detail, in this step, as described above, place names and facility names included in blocks of plural regions, which are obtained by dividing a country or a region targeted by this navigation apparatus at latitudes and longitudes, are formed as one unit voice recognition dictionary, and a place name/facility name recognition dictionary is formed as a set of the place names and the facility names. Thus, a present-location-corresponding-block-group voice recognition dictionary is set by selecting a block in which the present location is present and further selecting blocks in a predetermined range present around the block.

[0060] The voice recognition apparatus for navigation uses the voice recognition dictionary set in this way to perform retrieval processing for voice data corresponding to the characteristic parameter of the inputted voice (step S5). The voice recognition apparatus for navigation finds a place name or a facility name corresponding to the voice data and reads out various necessary data such as location data of a point where the place name or the facility name recorded together with the place name or the facility name is present. Since various retrieval methods conventionally used can be used for the retrieval processing of the voice recognition dictionary, an explanation of the retrieval processing is omitted.

[0061] The voice recognition apparatus for navigation judges whether a point corresponding to the place name or the facility name obtained as a result of the retrieval processing performed as described above is only one (step S6). When it is judged that the point is not only one, that is, plural points are present, the voice recognition apparatus for navigation performs processing for narrowing down the plural candidates (step S7). A processing flow for this processing is shown in Fig. 4. Although described later in detail, as described above, narrowing-down according to categories is performed in the plural-candidates-narrowing-down processing unit 20 in Fig. 1 and, if necessary, plural candidate points are arranged in an order of distance. The user refers to the candidate points and performs narrowing-down processing for

selecting a point

[0062] As a result of performing such narrowing-down processing, the voice recognition apparatus for navigation outputs an obtained voice recognition result to the display unit or the like and facilitates the user to confirm the result (step S8). Subsequently, the user judges whether the recognition result is appropriate (step S9). When it is judged that the recognition result is appropriate, the voice recognition apparatus for navigation judges whether voice input should be finished (step S10). When it is judged that the voice input is finished because, for example, the user does not perform new voice input during a predetermined period after that, the voice recognition apparatus for navigation ends this operation flow (step S13). When it is judged in step S6 that there is only one candidate as a result of the processing for retrieving voice recognition dictionaries, the voice recognition apparatus for navigation proceeds to step S8 immediately and confirms whether the obtained candidate is a place name or a facility name intended by the user.

[0063] On the other hand, when it is judged in step S3 that the voice inputted by the user does not include voice concerning a place name or a facility name, the voice recognition apparatus for navigation selects a dictionary for performing other voice recognition such as an operation function (step S11) and retrieves a word corresponding to the inputted voice using the dictionary.

The voice recognition apparatus for navigation displays a word obtained by the voice recognition on the display unit in the same manner as described above or performs an output such as utterance of voice inquiring whether a specific function may be performed and facilitates confirmation by the user.

[0064] When it is judged in step S10 that voice input is not finished, for example, when the user performs voice input again, the voice recognition apparatus for navigation returns to step S1 and repeats the same operations as described above. When the user judges in step S9 whether a confirmation output as a result of voice recognition is appropriate and it is judged that the recognition result is not a place name or a facility name intended by the user, the voice recognition apparatus for navigation inputs a signal indicating to that effect to thereby return to step 1, performs voice input for recognition again, and performs the same operations after that.

[0065] In performing the processing for setting voice recognition dictionaries for place names and facility names corresponding to the present location in step S4, for example, the processing can be performed according to the operation flow shown in Fig. 3. In the beginning of this processing, the voice recognition apparatus for navigation captures data of a present location (step S21). The present location input unit 10 in Fig. 1 performs this operation by capturing a signal from a present position detecting unit of the navigation apparatus 28.

[0066] In this embodiment, subsequently, the voice recognition apparatus for navigation judges processing for selecting a voice recognition dictionary to be performed is first processing (step S22). When it is judged that the processing is first processing for selecting a voice recognition dictionary, the voice recognition apparatus for navigation selects a present location belonging block (step S23). In this processing, the block can be found by forming a list, in which identification numbers are given in advance to, for example, block portions formed in portions where latitude division areas divided at latitudes and longitude division areas divided at longitudes shown in Fig. 5(a) cross each other, in the latitude/longitude division block voice recognition dictionary 13 of Fig. 1 and, when a present location is inputted, selecting a specific block according to latitude and longitude data of the list.

[0067] In performing actual block division, for example, as in the example of Japan shown in Fig. 9, latitudes and longitudes are divided by a unit of one degree. Latitude division areas are set as A1 to A16 and longitude division areas are set as B1 to B17 to thereby set portions where the latitude division areas and the longitude division areas cross as latitude/longitude division blocks. According to such block division, for example, most of Tokyo is included in a block (A6, B11). In performing such block division, the blocks may be fragmented appropriately or collected according to an amount of data of place names and facility names included

in each of the blocks.

[0068] Subsequently, the voice recognition apparatus for navigation selects peripheral blocks in a predetermined range of the block on the basis of a present location belonging block obtained as described above (step S24). The peripheral block selecting unit 12 in Fig. 1 performs this operation by selecting a block in a range decided in advance around the selected present location belonging block on the basis of data selected by the present-location-belonging-block selecting unit 11.

[0069] In selecting an actual peripheral block, it is possible to select a peripheral block as in the example shown in Fig. 10(a). In this example, when a block is divided at latitudes and longitudes as shown in Fig. 9, for example, a block (A6, B10) is selected as a present location belonging block because the present location is located in Yamanashi prefecture, and eight blocks in total around the block, namely, (A7, B9), (A6, B9), (A5, B9), (A7, B10), (A5, B10), (A7, B11), (A6, B11), and (A5, B11) are selected as peripheral blocks.

[0070] Thereafter, the voice recognition apparatus for navigation selects voice recognition dictionaries corresponding to the present location belonging block obtained in step S23 and the peripheral blocks in the predetermined range of the present location belonging block obtained in step S24 out of the latitude/longitude division block voice recognition dictionary 13, selects the voice recognition

dictionaries as a group of voice recognition dictionaries corresponding to blocks, and merges the group of voice recognition dictionaries into the present-location-corresponding-block-group voice recognition dictionary 14 (step S26). Thereafter, the voice recognition apparatus for navigation returns to step S21 again and repeats the same operations after that.

[0071] In creating the dictionary described above, other than collecting all of these data and recording the data in the storage unit temporarily, dictionaries used as present voice recognition dictionaries among the dictionaries present in the latitude/longitude division block voice recognition dictionary 13 may be simply collected as a list and recorded. When data in a form of a list is simply created in this way, in performing voice recognition processing, the voice recognition processing is executed by selecting only dictionaries of blocks present in the list in the latitude/longitude division block voice recognition dictionary 13 and performing retrieval when phoneme data corresponding to inputted voice is retrieved.

[0072] On the other hand, when it is judged in step S22 that the processing for selecting a voice recognition dictionary to be performed is not first processing, that is, selection of a voice recognition dictionary has already been performed, the voice recognition apparatus for navigation judges whether the present location belonging block has changed. In other words, when the

present location changes as the vehicle moves, the voice recognition apparatus for navigation detects whether the present location has deviated from the present location belonging block selected earlier. As a result, when it is judged that the present location belonging block has not changed, the voice recognition apparatus for navigation returns to step S21 again, continues to capture present location data, and repeats the same operations.

[0073] When it is judged in step S25 that the present location belonging block has changed, the voice recognition apparatus for navigation proceeds to step S23 and selects a present location belonging block in the same manner as described above. Subsequently, in step S24, the voice recognition apparatus for navigation selects predetermined peripheral blocks around the present location belonging block and repeats the same operations after that. In this embodiment, the voice recognition apparatus for navigation performs the block selection processing of step S23 and subsequent steps only when it is judged in step S25 that the present location belonging block has changed. Thus, the voice recognition apparatus for navigation does not perform the processing in step S23 and the subsequent steps every time present location data is captured to reduce processing burdens in the place name/facility name dictionary selection processing.

[0074] As a result of the processing for selecting voice recognition dictionaries according to movement of the present location described

above, for example, in the present location belonging block shown in Fig. 10(a) and the group of blocks corresponding to the present locations consisting of peripheral blocks, when the present location enters Tokyo from Yamanashi prefecture, the present location belonging block changes to a block (A6, B11) as shown in Fig. 10(b) and the peripheral blocks also move as shown in the figure following the change of the block. Moreover, when the present location enters Saitama prefecture from Tokyo and enters A7 from the latitude division area a6, the present location belonging block moves to a block (A7, B11) as shown in Fig. 10(c) and the peripheral blocks also move as shown in the figure following the change of the block. In this way, it is possible to also change a dictionary for performing voice recognition processing according to movement of the present location.

[0075] In performing the processing for narrowing down plural candidates in step S7 in Fig. 2, for example, it is possible to perform the processing in order in accordance with the operation flow shown in Fig. 4. In other words, when the processing for retrieving voice recognition dictionaries is performed in step S5 in Fig. 2 and, as a result of the processing, it is judged in step S6 that a retrieval result is not only one, that is, plural candidates are present, in the embodiment shown in Fig. 4, the voice recognition apparatus for navigation displays these plural candidates such that the user can confirm the candidates (step S31). Note that it is

also possible to set the processing such that the voice recognition apparatus for navigation immediately proceeds to the next step S32 without performing such screen display or set the processing such that the voice recognition apparatus performs display only when the number of candidates is within a predetermined number.

[0076] In step S32, in inputting a category to which a place name or a facility name intended by the user belongs, the voice recognition apparatus for navigation displays a list of categories for convenience of the input and retrieves phoneme data of the place name/facility name-voice-by-category recognition dictionary 15 in the voice-by-category recognizing unit 21 (step S33).

[0077] The voice recognition apparatus for navigation judges whether a candidate obtained as a result of the retrieval is only one (step S34). When it is judged that the candidate is not only one, that is, plural candidates are present, the voice recognition apparatus for navigation calculates distances from the present location for these plural candidates (step S35), rearranges the candidates in an order of closeness of the distance, and displays the candidates as a list (step S36).

[0078] Consequently, when a user desires to do shopping in, for example, 7-Eleven in the present location shown in Fig. 10(c), if the user designates the convenience store 7-Eleven as a category, the voice recognition apparatus for navigation displays, for example, a list shown in Fig. 11. The user looks at such a list to understand

that 7-Eleven Inabago is present in a closest place. Note that, instead of the list described above, the voice recognition apparatus for navigation may perform map display with the present location as a center and displays the facilities described above on the map. The user selects a desired facility name or the like while looking at the list display or the map display described above (step S37) and outputs a result of the selection (step S38).

[0079] The voice recognition apparatus for navigation according to the present invention operates as described above. However, other than the navigation apparatus used in Japan shown in Figs. 9 and 10, an effect of the present invention is particularly large if the present invention is used as a voice recognition apparatus for a navigation apparatus that can be used in the same manner in countries all over the world and, in particular, as a voice recognition apparatus for a navigation apparatus used in the United States. This is because a large number of place names and facility names are present in the vast land of the United States and burdens on a voice recognition processing device are too large if the place names and the facility names are collected into one voice recognition dictionary and used. In that case, for example, the voice recognition dictionary is divided at latitudes and longitudes as sown in Fig. 12. In this example, latitude division areas n1 to n10 and longitude division areas w1 to w24 are used, and regions where the latitude division areas and the longitude division areas cross are set as block units for dividing

the voice recognition dictionary, respectively. Note that, in the United States, in particular, many administrative divisions of states are along latitudes and longitudes. Thus, the method of dividing a block at latitudes and longitudes is easily adapted to the administrative divisions.

[0080] Consequently, in an example shown in Fig. 13, when a present location is present in a block (n7, w15), eight peripheral blocks are selected in the same manner as the example of Japan and voice recognition processing is performed using voice recognition dictionaries of nine blocks in total. As a result, the voice recognition dictionaries are changed as the present location moves from Fig. 13(a) as indicated by Figs. 13(b) and 13(c). Note that, in the embodiment shown in the figures, the example in which both latitudes and longitudes are set by a unit of 2.5 degrees is described. However, for example, a block may be divided into small blocks by a unit of one degree as shown in Fig. 14. In that case, as shown in the figure, it is also possible to divide a block into small blocks every one degree for a part with a high population density in the West Coast of the United States and divide a block into blocks every two degrees for other parts. In addition, a block may be divided into larger blocks for a region with a small population density such as an inland central part of the United States.

[0081] It is possible to carry out the present invention in the various forms as described above. However, it is also possible to

select peripheral blocks in various forms using voice recognition dictionaries divided at latitudes and longitudes in various forms. In addition, it is also possible to narrow down, when plural candidates are present as a result of voice recognition, the candidates in forms other than those in the embodiment.

[0082]

[Effects of the Invention] The present invention is constituted as described above. Thus, in order to solve the problems, the voice recognition apparatus for navigation according to the present invention includes: a block-unit-voice-recognition-dictionary accumulating unit having plural block-unit-voice-recognition dictionaries constituted by recorded phoneme data of place names and facility names, which are included in blocks divided at latitudes and longitudes and related data thereof, for each of the blocks; a present-location-corresponding-block-group selecting unit that selects a present location belonging block and peripheral blocks in a predetermined range around the present location belonging block; and a present-location-corresponding-block-group-voice recognition dictionary obtained by selecting a block unit voice recognition dictionary of a group of blocks selected by the present-location-corresponding-block-group selecting unit from the block-unit-voice-recognition-dictionary accumulating unit, and includes a voice recognition processing unit that retrieves phoneme data corresponding to inputted voice of a place name or

a facility name from the present-location-corresponding-block-group-voice recognition dictionary. Thus, in performing voice recognition processing using voice recognition dictionaries in which place names and facility names are set for each region, large processing burdens are not imposed on a voice recognition processing apparatus, it is possible to perform appropriate voice recognition processing, and it is possible to perform the same processing as voice recognition processing for recognizing voice out of a large quantity of data while using a small voice recognition dictionary. Consequently, it is possible to perform voice recognition at high speed and accurately using an inexpensive data processing apparatus.

[0083] In another voice recognition apparatus for navigation according to the present invention, the blocks divided at latitudes and longitudes are divided with a size of the blocks changed such that the quantities of place names and facility names included in each of the blocks are set as equal as possible. Thus, it is possible to reduce a degree of a change in burdens of voice recognition processing according to a region where a present location is present. It is possible to perform voice recognition at a high speed and accurately using an inexpensive data processing apparatus.

[0084] In another voice recognition apparatus for navigation according to the present invention, blocks around the block to which the present location belongs is set as blocks adjacent to the present

location belonging block. Thus, in selecting a region to be an object of voice recognition, it is possible to perform the selection easily.

[0085] In another voice recognition apparatus for navigation according to the present invention, the blocks around the block to which the present location belongs is adapted to include blocks adjacent to the present location belonging block and blocks in a predetermined range around the blocks. Thus, it is possible to select a range to be an object of voice recognition appropriately according to various situations. For example, it is possible to set a region to be an object of voice recognition in an arbitrary range and it is possible to select and set the range appropriately according to processing ability or the like of a voice recognition processing apparatus.

[0086] In another voice recognition apparatus for navigation according to the present invention, the blocks around the block to which the present location belongs are changed as the present location moves such that quantities of place names and facility names are set as equal as possible. Thus, even if the number of place names or facility names is large or small depending on a region where the present location is present, it is possible to equalize overall quantities of place names and facility names included in a group of blocks to be an object of voice recognition and it is possible to equalize processing burdens of voice recognition to perform appropriate voice recognition processing as the voice

recognition apparatus as a whole.

[0087] In another voice recognition apparatus for navigation according to the present invention, the voice recognition processing unit sets a degree of approximation of voice for a place name or a facility name included in the present-location-corresponding-block-group-voice recognition dictionary to be larger as the place name or the facility name is present in a block closer to the present location. Thus, for example, when a user searches for a convenience store near the present location, it is possible to retrieve a facility intended by the user appropriately. In particular, since a degree of approximation is calculated by a unit of block, a smaller memory capacity has to be required, arithmetic processing is easier, and burdens of voice recognition processing is reduced compared with the calculation of a degree of approximation for each place name or facility name by a unit of state, prefecture, or the like.

[0088] In another voice recognition apparatus for navigation according to the present invention, the present-location-corresponding-block-group-voice recognition dictionary consists of a list in which blocks of a group of preset location corresponding blocks are recorded, and the voice recognition processing unit retrieves a place name or a facility name having phoneme data corresponding to inputted voice from dictionary data of blocks recorded in the list of the

block-unit-voice-recognition-dictionary accumulating unit on the basis of the list in which the blocks are recorded. Thus, data recorded in the present-location-corresponding-block-group-voice recognition dictionary only has to be a very small one consisting of only list data, it is possible to reduce burdens of rewrite processing for data, and it is possible to obtain an inexpensive voice recognition apparatus.

[0089] In another voice recognition apparatus for navigation according to the present invention, when a block to which a present location belongs changes because of movement of the present location and the present-location-belonging-block selecting unit selects a new present location belonging block, processing for selecting peripheral blocks is performed. Thus, it is unnecessary to perform the processing for selecting peripheral blocks every time the present location moves and it is possible to simplify processing for selecting a voice recognition dictionary.

[0090] Another voice recognition apparatus for navigation according to the present invention includes a plural-candidates-narrowing-down processing unit. The plural-candidates-narrowing-down processing unit performs narrowing-down processing when plural candidates are present as a result of voice recognition processing by the present-location-corresponding-block-group-voice recognition dictionary. Thus, when plural candidates are present as a result

of performing voice recognition processing using the present-location-corresponding-block-group-voice recognition dictionary, it is possible to narrow down and output only appropriate candidates out of the candidates and it is possible to obtain a voice recognition apparatus that is easy to use.

[0091] Another voice recognition apparatus for navigation according to the present invention includes a voice-by-category recognition dictionary in which place names and facility names are recorded for each category. The plural-candidates-narrowing-down processing unit is adapted to perform voice recognition processing using the voice-by-category recognition dictionary corresponding to a category instructed by a user. Thus, when plural candidates are present as a result of performing voice recognition processing using the present-location-corresponding-block-group-voice recognition dictionary, it is possible to retrieve a place name or a facility name in association with a category instructed by the user using the voice-by-category recognition dictionary prepared separately and it is possible to perform more accurate voice recognition processing.

[0092] In another voice recognition apparatus for navigation according to the present invention, the plural-candidates-narrowing-down processing unit calculates distances from the present location for plural candidates obtained as a result of voice recognition processing, respectively, and

displays the plural candidates in order as a list on a display unit according to an output of the candidate-point-distance-order arranging unit such that the user selects a place name or a facility name according to the list. Thus, the user can arbitrarily perform selection or the like of a place name or a facility name closer to the present location among the plural candidates or a place name or a facility name closest to the present location when other conditions are taken into account. It is possible to recognize a place name or a facility name intended by the user accurately.

[0093] Another voice recognition apparatus for navigation according to the present invention is adapted to calculate distances from the present location for plural candidates obtained as a result of voice recognition processing, respectively, and output a candidate with a closest distance as a result of voice recognition. Thus, it is possible to automatically output a candidate, which is considered to be most appropriate, among the plural candidates. It is possible to obtain a voice recognition apparatus that does not bother the user and is easy to use.

[Brief Description of the Drawings]

[Fig. 1] A functional block diagram in an embodiment of the present invention.

[Fig. 2] A flow diagram of a basic operation in the embodiment.

[Fig. 3] A flow diagram of an operation for performing present location corresponding place name/facility name voice recognition

dictionary setting processing in the flow diagram of a basic operation.

[Fig. 4] A flow diagram of an operation for performing processing for narrowing down plural candidates in the flow diagram of a basic operation.

[Fig. 5] A diagram showing an example in which a voice recognition dictionary in the present invention is divided at latitudes and longitudes and a present location belonging block and peripheral blocks are selected, in which part (a) shows an example of a latitude/longitude division block, part (b) shows an example of selection of the present location belonging block and the peripheral blocks, part (c) shows an example in which a present location moves among blocks, and part (d) shows an example in which a voice recognition dictionary is changed when the present location belonging block is changed.

[Fig. 6] A diagram showing an example of selection of peripheral blocks in the present invention, in which part (a) shows an example in which the peripheral blocks are set in plural forms and part (b) shows an example in which the peripheral blocks are set in other forms.

[Fig. 7] A diagram showing an example in which a specific region is fragmented in dividing the voice recognition dictionary in the present invention at latitudes and longitudes, in which part (a) shows an example in which the voice recognition dictionary is divided

in one kind of form and part (b) shows an example in which the voice recognition dictionary is divided in two kinds of forms.

[Fig. 8] A diagram showing an example in which a group of present location corresponding blocks changes according to movement of a present location when a specific region is fragmented in dividing the voice recognition dictionary in the present invention at latitudes and longitudes.

[Fig. 9] A diagram showing an embodiment in which a voice recognition dictionary creating method of dividing a voice recognition dictionary at latitudes and longitudes in the present invention is applied to creation of a voice recognition dictionary of place names and facility names throughout Japan.

[Fig. 10] A diagram showing a group of present location corresponding blocks for voice recognition in the embodiment of Japan, in which parts (a), (b), and (c) show examples in which the group of present location corresponding blocks change according to movement of a present location, respectively.

[Fig. 11] A diagram showing an example in which plural candidates obtained as a result of voice recognition processing are narrowed down according to a specific category, arranged according to distances from a present location, and displayed on a screen.

[Fig. 12] A diagram showing an embodiment in which the voice recognition dictionary creating method of dividing a voice recognition dictionary at latitudes and longitudes in the present

invention is applied to creation of a voice recognition dictionary of place names and facility names in the United States.

[Fig. 13] A diagram showing a group of present location corresponding blocks for voice recognition in the embodiment of the United States, in which parts (a), (b), and (c) show examples in which the group of present location corresponding blocks change according to movement of a present location, respectively.

[Fig. 14] A diagram showing an example in which a voice recognition dictionary is fragmented for the West Coast part where there are a particularly large number of place names and facility names in this embodiment.

[Fig. 15] A functional block diagram showing an example of a voice recognition apparatus for navigation that have been used conventionally and to which the present invention is applied.

[Description of Symbols]

1 microphone

4 voice recognizing unit

5 voice recognition dictionary unit

6 place name/facility name dictionary unit

7 dictionary for other functions such as an operation function

9 present-location-corresponding-block-group selecting unit

10 present location input unit

11 present-location-belonging-block selecting unit

12 peripheral block selecting unit

13 latitude/longitude division block unit voice recognition dictionary accumulating unit

14 present-location-corresponding-block-group-voice recognition dictionary

15 place name/facility name-voice-by-category recognition dictionary

20 plural-candidates-narrowing-down processing unit

21 voice-by-category recognizing unit

22 candidate-point-arrangement-in-order-of-distance narrowing down unit

23 plural-candidates-list-display output unit

26 output confirming unit

FIG. 1

1: MICROPHONE

2: VOICE INPUT UNIT

3: VOICE CHARACTERISTIC PARAMETER EXTRACTING UNIT

4: VOICE RECOGNIZING UNIT

5: VOICE RECOGNITION DICTIONARY UNIT

6: PLACE NAME/FACILITY NAME DICTIONARY UNIT

7: DICTIONARY OF OTHER FUNCTIONS SUCH AS OPERATION FUNCTION

9: PRESENT-LOCATION-CORRESPONDING-BLOCK-GROUP SELECTING UNIT

10: PRESENT LOCATION INPUT UNIT

11: PRESENT-LOCATION-BELONGING-BLOCK SELECTING UNIT

12: PERIPHERAL BLOCK SELECTING UNIT

13:

LATITUDE/LONGITUDE-DIVISION-BLOCK-UNIT-VOICE-RECOGNTIION-DICTI

ONARY ACCUMULATING UNIT

14: PRESENT-LOCATION-CORRESPONDING-BLOCK-GROUP-VOICE RECOGNITION

DICTIONARY

15: PLACE NAME/FACILITY NAME-VOICE-BY-CATEGORY RECOGNITION

DICTIONARY

20: PLURAL-CANDIDATES-NARROWING-DOWN PROCESSING UNIT

21: VOICE-BY-CATEGORY RECOGNIZING UNIT

22: CANDIDATE-POINT-ARRANGEMENT-IN-ORDER-OF-DISTANCE NARROWING

DOWN UNIT

23: PLURAL-CANDIDATES-LIST-DISPLAY OUTPUT UNIT

24: DISPLAY UNIT

25: OPERATION SIGNAL INPUT UNIT

26: OUTPUT CONFIRMING UNIT

27: RECOGNITION RESULT OUTPUT UNIT

28: NAVIGATION APPARATUS

FIG. 2

VOICE RECOGNITION PROCESSING

S1: INPUT RECOGNITION VOICE

S2: EXTRACT VOICE CHARACTERISTIC PARAMETER

S3: VOICE CONCERNING PLACE NAME OR FACILITY NAME IS INCLUDED?

S4: PROCESSING FOR SETTING PLACE NAME/FACILITY NAME VOICE RECOGNITION DICTIONARY CORRESPONDING TO PRESENT LOCATION

S5: PROCESSING FOR RETRIEVING VOICE RECOGNITION DICTIONARY

S6: RETRIEVAL RESULT IS ONLY ONE?

S7: PROCESSING FOR NARROWING DOWN PLURAL CANDIDATES

S8: OUTPUT FOR CONFIRMING RESULT OF VOICE RECOGNITION

S9: RECOGNITION RESULT IS APPROPRIATE?

S10: VOICE INPUT ENDS?

S11: SELECT VOICE RECOGNITION DICTIONARY FOR OTHER FUNCTIONS SUCH AS OPERATION FUNCTION

S12: PROCESSING FOR RETRIEVING VOICE RECOGNITION DICTIONARY

S13: END

FIG. 3

PROCESSING FOR SETTING PLACE NAME/FACILITY NAME VOICE RECOGNITION DICTIONARY CORRESPONDING TO PRESENT LOCATION

S21: CAPTURE PRESENT LOCATION DATA

S22: FIRST PROCESSING FOR SELECTING VOICE RECOGNITION DICTIONARY?

S23: SELECT PRESENT LOCATION BELONGING BLOCK

S24: SELECT PREDETERMINED PERIPHERAL BLOCKS OF PRESENT LOCATION BELONGING BLOCK

S25: PRESENT LOCATION BELONGING BLOCK HAS CHANGED?

S26: SELECT GROUP OF BLOCK CORRESPONDING VOICE RECOGNITION DICTIONARIES OF PRESENT LOCATION BELONGING BLOCK AND PREDETERMINED PERIPHERAL BLOCKS THEREOF AND SET THE DICTIONARIES AS PRESENT LOCATION CORRESPONDING VOICE RECOGNITION DICTIONARY

FIG. 4

PROCESSING FOR NARROWING DOWN PLURAL CANDIDATES

S31: DISPLAY SCREEN FOR SELECTING PLURAL CANDIDATES

S32: DISPLAY CATEGORY LIST

S33: RETRIEVE VOICE RECOGNITION DICTIONARY CORRESPONDING TO CATEGORY

S34: RETRIEVAL RESULT IS ONLY ONE?

S35: CALCULATE DISTANCES FROM PRESENT LOCATION OF PLURAL CANDIDATES

S36: DISPLAY LIST IN ORDER OF CLOSENESS OF DISTANCE

S37: SELECTION BY USER

S38: OUTPUT SELECTION RESULT

FIG. 5

(A) EXAMPLE OF LATITUDE/LONGITUDE DIVISION BLOCKS FOR DIVIDING VOICE RECOGNITION DICTIONARY

LATITUDE

LONGITUDE

(B) EXAMPLE OF SELECTION OF PRESENT LOCATION BELONGING BLOCK AND PERIPHERAL BLOCKS

(C) EXAMPLE OF MOVEMENT AMONG BLOCKS OF PRESENT LOCATION

(D) EXAMPLE OF CHANGE OF VOICE RECOGNITION DICTIONARY AT THE TIME OF CHANGE OF PRESENT LOCATION BELONGING BLOCK

FIG. 6

(A)

LATITUDE

LONGITUDE

(B)

LATITUDE

LONGITUDE

FIG. 7

(A) EXAMPLE OF FRAGMENTATION OF BLOCKS IN REGIONS WITH LARGE NUMBER OF PLACE NAMES AND FACILITY NAMES

(B) EXAMPLE OF FRAGMENTATION OF BLOCKS IN REGIONS WITH PARTICULARLY

LARGE NUMBER OF PLACE NAMES AND FACILITY NAMES

FIG. 8

(A) EXAMPLE OF SELECTION OF VOICE RECOGNITION DICTIONARY 1

(B) EXAMPLE OF SELECTION OF VOICE RECOGNITION DICTIONARY 2

(C) EXAMPLE OF SELECTION OF VOICE RECOGNITION DICTIONARY 3

FIG. 11

CATEGORY RETRIEVAL RESULT DISTANCE ORDER LIST

CATEGORY

CONVENIENCE STORE

7-ELEVEN

NAME

7-ELEVEN INABAGO

7-ELEVEN MAMADA

7-ELEVEN KOYAMA JOYAMA

7-ELEVEN KOYAMA OTOME

7-ELEVEN KOYAMA EKI HIGASHI

7-ELEVEN KOYAMA AWAMIYA

DISTANCE

FIG. 14

EXAMPLE OF FORMATION OF UNIT BLOCK BY UNIT OF ONE DEGREE OF LATITUDE AND LONGITUDE IN MAJOR PART OF UNITED STATE

NORTH LATITUDE

WEST LONGITUDE

FIG. 15

30: NAVIGATION APPARATUS

31: SYSTEM CONTROL UNIT

32: MAP/INFORMATION STORAGE MEDIUM

33: MAP/INFORMATION DATA

34: PLACE NAME/FACILITY NAME CORRESPONDING POINT DATA

35: MAP RENDERING UNIT

36: IMAGE COMPOSING UNIT

37: IMAGE DISPLAY DEVICE

40: MANUAL OPERATION INPUT UNIT

41: PRESENT LOCATION DETECTING UNIT

42: GUIDING ROUTE CALCULATING UNIT

43: GUIDING ROUTE SHOWING UNIT

44: DESTINATION/COURSE POINT SETTING UNIT

45: PLACE NAME/FACILITY NAME FOR RETRIEVAL INPUT UNIT

46: POINT DATA RETRIEVING UNIT

47: POINT DATA OUTPUT UNIT

50: VOICE RECOGNITION APPARATUS

51: MICROPHONE

52: VOICE INPUT UNIT

53: VOICE CHARACTERISTIC PARAMETER EXTRACTING UNIT

54: VOICE RECOGNIZING UNIT

55: VOICE RECOGNITION DICTIONARY UNIT

56: PLACE NAME/FACILITY NAME DICTIONARY UNIT

57: DICTIONARY UNIT FOR OPERATION FUNCTION AND THE LIKE

58: RECOGNITION RESULT OUTPUT UNIT